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## **THE RELATIONSHIP BETWEEN BACKGROUND LEVELS AND ACTIVITY NOISE LEVELS AT SCHOOL**

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**ABSTRACT**

The purpose of the present study was to evaluate noise levels during classroom work and also to find possible relations between background levels and activity noise levels generated by pupils at class. Sound levels were recorded in 25 classrooms chosen at three different, still typical schools in the northern part of Sweden. Recordings were made in occupied and in unoccupied classrooms. The recordings were analysed according to A-weighted levels. The levels during lessons ranged from 43 to 68 dB(A). The differences between background noise levels and activity noise levels were 12 – 26 dB. The results indicates a relationship between the background levels and activity noise levels.

### **1 - INTRODUCTION**

A survey by the Swedish National Board of Occupational Safety and Health in 1997 [1] showed that the second most common environmental problem at school is "noise, sound and acoustic problems". Beside noise emanating from activities in the classroom there is also background noise from ventilation and activities in other parts of the building.

Measurements of typical classroom levels have been reported, most pertain to preuniversity classrooms. Markides [2] reports of student activity noise levels of 50-70 dB. Pekkarinen and Viljanen [3] studied 31 classrooms when occupied and unoccupied and reports of activity noise levels of 40-58 dB. In Sweden Lundquist et al. [4] measured sound levels during maths lessons in upper elementary school. Sound levels during class varied from 58-69 dB(A). The Swedish National Board of Occupational Safety and Health [5] recommends that the background sound level in environments with high permanent demands on concentration and communication should not exceed 40 dB(A) to avoid negative effects as annoyance. National Board of Health and Welfare in Sweden [6] points out that school is a critical environment since noise affects speech communication and concentration and that classrooms may require background sound levels as low as 25 dB to reach an acceptable speech intelligibility for certain sensitive groups. Further, they claims that high background level in for example day-care and schools often leads to raised total sound levels due to the cause that the students raises their voices and adapt to the background level.

To find measures supporting a good sound environment in classroom environments it is important to investigate the relationship between different sound environmental factors. The purpose of the present study was to make an interdicting study on a possible relationship between students activity noise level and the background level.

### **2 - METHOD**

#### **2.1 - Design**

Sound levels were recorded in 25 classrooms chosen at three typical schools in Sweden. Noise recordings were made under similar conditions in unoccupied and occupied classrooms. Eight classrooms with the lowest background noise was compared with eight classrooms with the highest background level with regard to activity noise level.

#### **2.2 - Noise measurements**

The noise was recorded using a sound level meter (B&K 2237) with a 1/2" microphone (B&K 4189) and a digital tape recorder (TEAK DA-P20). The sound level meter was placed at an asymmetrical position

in the classroom corresponding to the ear height of the students. The measurements were made for 10 minutes in unoccupied classrooms and for 20 minutes in occupied classrooms. The first and last ten minutes of a 40 minute lesson were excluded because of the start up and ending procedure of the lesson. The recordings were analysed according to A-weighted equivalent levels.

### 2.3 - Environments

All measurements were made during similar conditions, with the students sitting down in a classroom working individually on mathematics or language. During the measurement period the teacher was helping the students, not lecturing.

### 2.4 - Data analysis

To examine possible differences in activity noise and its relation to background noise level, a Mann-Whitney U-test was calculated. The level of significance was set to  $p=0.05$ .

## 3 - RESULTS

For the eight classrooms with the lowest background levels the mean level was 35 dB(A). In these classrooms the mean activity noise level was 55 dB(A). The mean background level for the eight classrooms with the highest background levels was 40 dB(A). The mean activity noise level in these classrooms was 63 dB(A).

This observation that the activity noise level is higher in classrooms with higher background level is supported by the statistical analysis ( $p<.05$  Mann Whitney U-test).

School	Classroom	Students	Boys	Subject	Occupied ( $L_{eq(A)}$ )	Unoccupied ( $L_{eq(A)}$ )
B	2	16	13	German	62	33
B	1	17	8	Maths	53	34
B	4	18	12	Maths	56	34
B	5	24	15	English	47	34
B	8	19	8	Maths	53	34
B	6	21	13	Maths	61	35
A	4	12	1	Maths	50	36
A	2	16	9	Maths	49	37
B	3	19	9	Swedish	54	37
C	1	23	12	English	63	37
C	2	15	7	Swedish	55	37
A	1	13	7	Maths	60	38
C	5	18	9	Maths	52	38
C	6	16	5	Maths	52	38
C	3	11	4	Maths	59	39
C	4	14	5	Maths	51	39
C	8	22	9	English	63	39
A	5	27	16	English	68	40
A	6	13	9	English	64	40
B	7	23	14	Swedish	60	40
C	7	24	8	English	66	40
A	7	13	7	English	63	41
A	8	16	10	English	56	41
A	9	11	5	English	53	41
A	3	9	7	Maths	60	42

**Table 1:** Participants in the study (number of students and number of boys in each class), type of subject during recordings; the sound levels are given in  $L_{eq(A)}$  for unoccupied and occupied classrooms.

## 4 - DISCUSSION

According to the Swedish recommendations for background sound levels in school environments the levels in the classrooms in this study is quite high [5, 6]. Measurements of the student activity noise is similar to former findings [2, 3, 4] and considered to be normal for this kind of environments. The statistical analysis of this material points out that there is a difference in student activity noise level between groups

in classrooms with low background level compared to student groups in classrooms with high background level.

However, there are lots of factors that may affect the activity sound level in a classroom. Low frequency components, variability and peaks are factors to take into consideration. It is likely to assume that larger classes generates a higher activity sound level. Boys tends to be more lively and noisy than the girls so the number of boys in each class may also be a factor of importance. Differences in the teaching method and type of subject are also factors which may have an affect on the sound environment during class. The school environment is complex and there are many factors beside noise affecting the sound environment and the overall working climate. To find measures supporting a good sound environment in school all these factors have to be considered.

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